2.0 Alvar Communities: Composition, Distribution, and Status

In North America, alvar vegetation was first described from an area near Kingston, Ontario by Beschel (1965). Following Beschel's lead, Paul Catling and colleagues began to search for and study alvar sites in Ontario, and they described alvar flora in Ontario (Catling et al. 1975). In Michigan, alvar plant communities were first described by Stephenson and Herendeen (1986), and in New York they were first described by Reschke (1990a). Research on alvar sites was conducted by several graduate students, resulting in several more descriptions of alvar vegetation in the region (Belcher 1992; Belcher et al. 1992, Gilman 1995; Goodban 1995; Schaefer 1996e; Schaefer et al. 1997). A regional study of alvar flora in the Great Lakes region was published by Catling and Brownell (1995).

Consequently, when the Alvar Initiative project began, there were numerous descriptions and classifications of alvar plant communities in use in Ontario, New York, and Michigan. It was difficult, however, to compare the results of the different studies, because they used different criteria to sample and describe the plant communities. So an important objective of the Alvar Initiative was to provide consistency by developing a uniform sampling methodology for gathering vegetation data, using these methods to survey a wide variety of alvar sites across the Great Lakes region, and then using results of these field studies to develop a single regional classification of alvar community types.

This new classification provides the basic inventory data to compare alvar sites across state and international boundaries so that regional conservation priorities for alvar sites can be identified. The regional classification of alvar communities generated by the Alvar Initiative has already been incorporated into the Ecological Land Classification program in Ontario (Lee et al. 1998), and is being added to The Nature Conservancy's national vegetation classification system in the United States (Grossman et al.1998; Anderson et al.1998).

2.1   Summary of Community Inventory Methods

Inventory methods for the Alvar Initiative were developed and refined by the Alvar Working Group. After agreeing on a common definition of alvar sites as described above,

the scientists attending the 1995 Alvar Working Group meeting broke into multiple discussion groups, one each to discuss inventory methods for communities, rare plants, nonvascular plants, land snails, and other invertebrates. Some further refinement of field methods was finalized in the field form instructions for communities. Decisions on inventory methods were generally reached by consensus of collaborators.

Locating Alvar Sites

Many of the alvar sites that were surveyed as part of this project were already known to some extent from previous field surveys and publications. Paul M. Catling and Vivian R. Brownell had visited many sites in Ontario, collecting plant species data; the results of their surveys were published in three publications (Catling et al. 1975; Catling and Brownell 1995; and Catling 1995). In Michigan, New York, and Ohio, many alvar sites had been located by the Natural Heritage Program staff in each state.

Since a review of aerial photographs and geology maps had been useful in locating new alvar sites in northern New York (Reschke 1990b), a similar technique relying primarily on review of aerial photographs was applied in Ontario and Michigan to identify a few new sites. In Michigan and New York, all potential alvar sites identified in aerial photographs were visited (either as part of Alvar Initiative surveys or during previous surveys). The large number of potential sites in Ontario and the limited number of field surveyors made it difficult to visit every potential alvar site in the province. A list of sites provided by Vivian Brownell was reviewed to identify sites expected to be the largest and least disturbed for field surveys. Some sites were determined to be too small or disturbed to warrant further surveys for this project and, in a few cases, landowners denied permission for field access.

Altogether 103 survey sites were visited as part of Alvar Initiative field surveys (see Map A), and data on an additional 18 sites that had been previously surveyed were compiled from collaborators. Together, these included 27 sites in Michigan, 72 in Ontario, 10 in New York, four in Ohio, five in Quebec, one in Wisconsin, and two in Illinois. Seven of the Ontario sites were too small or disturbed to be included in our community summaries. The Illinois sites were identified as closely related to alvar, but not alvar under our definition.   The Quebec sites were not visited as part of this project and deserve further study. (During 1998, Quebec botanists initiated a floristic survey of the Outaouais region and identified 16 alvar sites, mostly near the Ottawa River.)
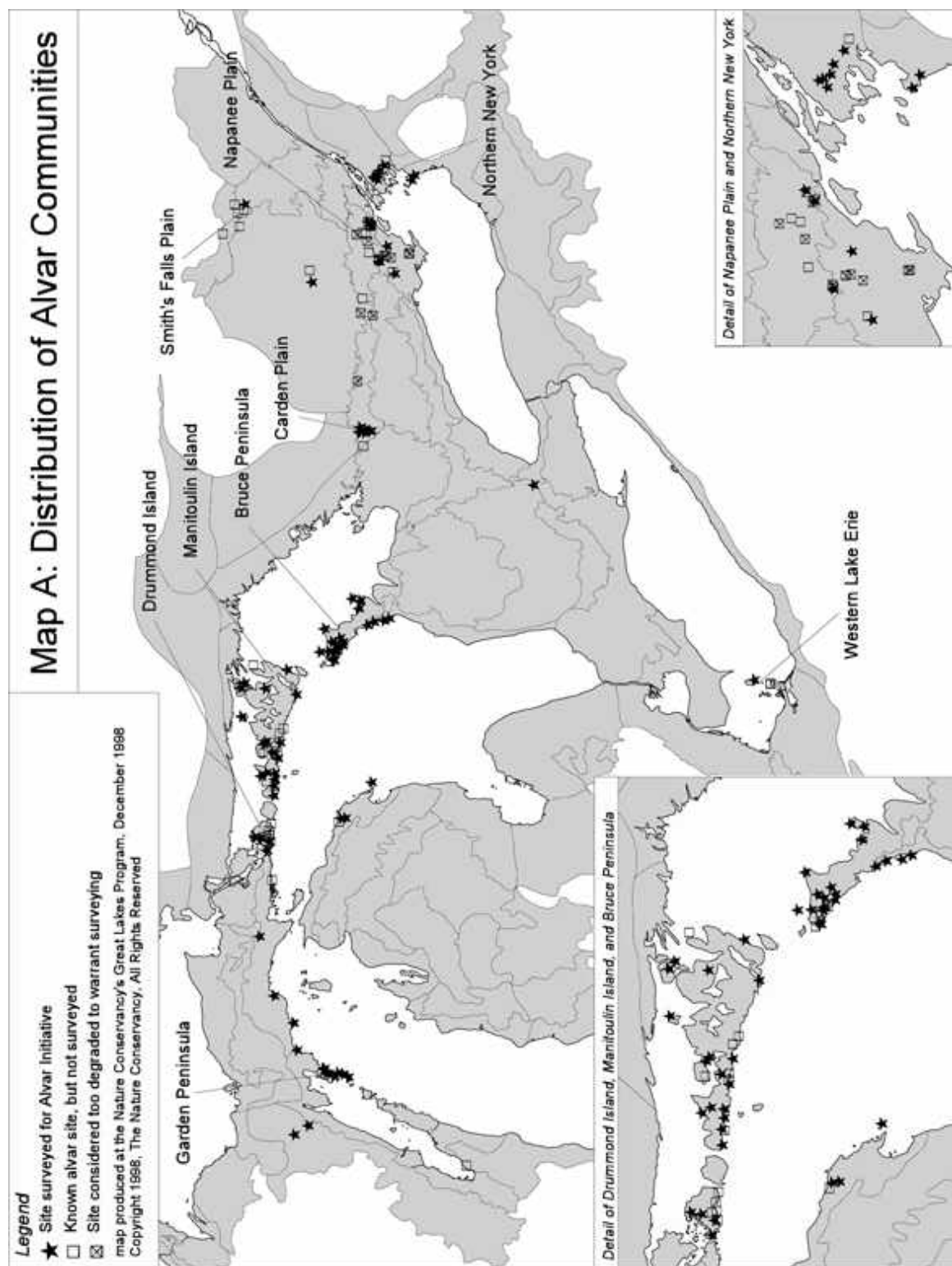
Community Surveys

The community inventory methods were designed to gather two kinds of data: basic inventory data, and preliminary research data on ecological processes.

Basic inventory methods were derived from standard methods developed for Natural Heritage Programs (Sneddon 1994; Grossman et al. 1998). Three types of community surveys were used to represent three levels of detail: 1) reconnaissance observation points, 2) species lists by community, and 3) quantitative sample plots. Details of community inventory field forms are provided in Appendix 1.

Reconnaissance observation points were used to briefly document the different community types 0.5 ha or larger that the surveyor encountered while walking through a site. The route walked was considered a transect, and each stop the surveyor made along the way to describe the community type was an observation

Map A: Distribution of Alvar Communities

Legend
★ Site surveyed for Alvar Initiative
☐ Known alvar site, but not surveyed
⊠ Site considered too degraded to warrant surveying

map produced at the Nature Conservancy's Great Lakes Program, December 1998
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Napanee Plain
Smith's Falls Plain
Carden Plain
Bruce Peninsula
Manitoulin Island
Drummond Island
Garden Peninsula
Northern New York
Western Lake Erie

Detail of Napanee Plain and Northern New York

Detail of Drummond Island, Manitoulin Island, and Bruce Peninsula

point. The objective was to record at least one observation point in each community present at a site and briefly describe any vegetation or environmental gradient observed. At each observation point the surveyor recorded the most abundant plant species in each layer of the vegetation, including tree canopy, tall shrubs, short shrubs, dwarf shrubs, herbaceous plants, and nonvascular plants (e.g. lichens, mosses).A consistent community classification scheme was used for all jurisdictions so that species list data were compiled in a consistent manner. The preliminary classification adopted was a physiognomic classification that roughly followed the alvar classification suggested by Catling and Brownell (1995). This physiognomic classification included six alvar types defined by vegetation structure. There were three categories of ground cover: pavement, grassland and shrubland. The pavement types each had at least 50% of the ground surface with exposed bedrock (which may include any cover of crustose lichens and mosses). Grassland types had at least 50% cover of grasses and sedges, and less than 25% cover of shrubs. Shrublands had at least 25% cover of shrubs. These three types (pavement, grassland, and shrubland) were each split into two groups based on the presence and cover of trees. If trees over 5 m tall shaded more than 10% of the ground surface, then the physiognomy was recognized as a savanna type; if there was less than 10% cover of trees, then it was considered an open type.

These six resultant physiognomic types were initially recognized: alvar pavement, alvar grassland, alvar shrubland, alvar pavement savanna, alvar savanna grassland, and alvar savanna shrubland.

Once surveyors had identified structural types at a site, they documented all the plant species observed within each type. Separate species lists were compiled for each of the six structural types present at each alvar site surveyed.

Quantitative data were recorded from 85 plots, each 10 m by 10 m square, which were selected to represent the best examples of the variety of alvar communities observed during field surveys. Within the plot, the surveyor noted all species in each layer of vegetation present (e.g. trees, tall shrubs, short shrubs, herbs, nonvascular plants) and the percentage of cover for each layer within the boundaries of the plot. Environmental data such as soil depth were also recorded for each plot.

Data from the 85 plots and 120 species lists were entered in spreadsheets and evaluated using standard community analysis software in the PCORD set of programs (McCune and Mefford 1997). Details of the data analysis are

provided in Appendix 2. These results were discussed by a small group of collaborators, including Carol Reschke, Wasyl Bakowsky, Pat Comer, Judith Jones, Don Faber-Langendoen, Don Cuddy, and Bruce Gilman, to develop a final recommended classification of alvar communities (which replaced the preliminary six structural types), community descriptions, and draft ranking specifications.

The scientific names of the communities were adjusted to be consistent with The Nature Conservancy's national vegetation classification (Grossman et al. 1998, Anderson et al. 1998). Table 1 lists the recommended alvar community types with their technical names (scientific and common names used in the Biological and Conservation Data System (BCD), global ranks, and global element codes (the file locator codes in BCD software). Since the national classification community names have not yet been incorporated into all the state or provincial heritage databases, a cross-referencing table with the corresponding state or provincial community names is provided in Appendix 3.

While the community classification arrived at through the International Alvar Conservation Initiative provides a framework to describe and evaluate alvar sites in the Great Lakes basin, other systems may provide useful definition at a more detailed level. Within Ontario, for instance, Brownell recognizes two broad groups of alvars: shoreline and plateau. Within plateau alvars, she has proposed a preliminary classification based on three series: open alvar, savanna, and woodland. A further preliminary subdivision of each of these series into classes and associations proposes the following:

- five pavement, five grassland, and three shrubland associations within the open alvar series

- one pavement, five grassland, and two shrubland associations within the savanna series

- yet to be defined associations within the woodland series   (Brownell 1998)

This classification system and its relationship to the Alvar Initiative communities will be further developed in the Ontario Alvar Theme Study (in preparation).

Conservation Rankings for Alvar Communities and Species

The ranking system used by the Alvar Initiative was developed by The Nature Conservancy to describe the conservation status of communities and species at multiple scales. For those unfamiliar with this system, a brief introduction to the terms used and the steps involved is provided here. More details about

technical specifications for each alvar community type and how ranks were assigned is provided in Appendix 3.

As part of the TNC system, alvar communities and species were assigned "global ranks," which represent the conservation status of each community or species on a global scale. TNC's global ranks range from G1 for critically imperiled (very few occurrences anywhere in the world and highly threatened) to G5 for demonstrably secure (many occurrences worldwide and many of those in some sort of conservation management or ownership). State or provincial ranks, which currently are only partly complete for alvar communities, are assigned by Heritage Program staff to represent the status of communities and species within state or provincial boundaries. These "subnational" ranks are parallel to the global ranks, ranging from S1 for imperiled in

orig. type number	Alvar Initiative Community (BCD Synonym)	global rank	total # EO's	total acres	BCD global scientific name	BCD global elcode
	Table 1: Final Alvar Initiative Community Types - December 15, 1998					
	ALVAR COMMUNITIES:					
2	tufted hairgrass wet alvar grassland	G2	36	3440	Deschampsia cespitosa - (Sporobolus heterolepis - Schizachyrium scoparium) - Carex crawei - Senecio pauperculus herbaceous vegetation	CEGL005110
3	little bluestem alvar grassland	G2	36	7074	Sporobolus heterolepis - Schizachyrium scoparium (Carex scirpoidea / Juniperus horizontalis) herbaceous vegetation	CEGL005234
4	annual alvar pavement-grassland	G2	16	490 +	Sporobolus neglectus - S. vaginiflorus - Trichostema brachiatum - Panicum philadelphicum - (Poa compressa) herbaceous vegetation	CEGL005235
7	alvar nonvascular pavement	G2	19	1424	Tortella tortuosa - Cladonia pocillum - Placynthium spp. sparse vegetation	CEGL005192
13	poverty grass dry alvar grassland	G2?	17	467	Danthonia spicata - Poa compressa - (Schizachyrium scoparium) herbaceous vegetation	CEGL005100
5	creeping juniper - shrubby cinquefoil alvar pavement	G2	24	2700	Juniperus horizontalis - Pentaphylloides floribunda / Schizachyrium scoparium - Carex richardsonii dwarf-shrubland	CEGL005236
6	scrub conifer / dwarf lake iris alvar shrubland	G1G2	10	815	Picea glauca - Thuja occidentalis - Juniperus communis / Iris lacustris - Carex eburnea shrubland	CEGL005211
8	juniper alvar shrubland	G3	35	7768	Juniperus communis - (J. virginiana) - Rhus aromatica - Viburnum rafinesquianum / Solidago ptarmicoides shrubland	CEGL005212
10	shagbark hickory / prickly ash alvar savanna (Flamborough Plains type)	G?	1 #	10 #	Carya ovata / Zanthoxylem americanum / Panicum philadelphicum - Carex pensylvanica wooded herbaceous vegetation	CEGL005230
11	Chinquapin oak - nodding onion alvar savanna (Pelee Island type)	G1?	1	30	Quercus muehlenbergii - Poa spp. - Allium cernuum - Eleocharis compressa / Aulacomnium palustre - Bryum spp. wooded herbaceous vegetation	CEGL005133
14 & 15	white cedar - jack pine / shrubby cinquefoil alvar savanna	G1G2	11 +	812 +	Thuja occidentalis - Pinus banksiana / Pentaphylloides floribunda / Calamintha arkansana wooded herbaceous vegetation	CEGL005132
16	mixed conifer / common juniper alvar woodland	G2?	9 +	1334 +	Pinus banksiana - Thuja occidentalis - Picea glauca / Juniperus communis woodland	CEGL005126
17	red cedar / early buttercup alvar woodland	G3?	3 +	107 +	Juniperus virginiana / Ranunculus fascicularis woodland	CEGL005122
	OTHER COMMUNITIES STUDIED:					
1**	river ledge limestone pavement	G1	4	45 +	Spartina pectinata - Muhlenbergia richardsonis - Sporobolus heterolepis - Solidago ptarmicoides - Euthamia graminifolia herbaceous vegetation	CEGL005255
9**	Great Lakes limestone bedrock lakeshore	G3	18 #	453 #	Pentaphylloides floribunda / Calamintha arkansana - Potentilla anserina - Primula mistassinica sparse vegetation	CEGL002506
12**	bur oak limestone savanna	G1?	3 #	1112 #	Quercus macrocarpa / Danthonia spicata - (Geum triflorum) limestone wooded herbaceous vegetation	CEGL005237
IL** reports	midwest wet-mesic dolomite prairie (5180), OR: tufted hairgrass - prairie cordgrass - little bluestem	G2?	not sampled	not sampled	Deschampsia cespitosa - Spartina pectinata - Schizachyrium scoparium - Solidago ohioensis herbaceous vegetation	CEGL005180
**	*indicates alvar-related communities that occur on limestone or dolomite outcrops, but are not considered alvar types for this project; data were collected from a few examples of these types for the alvar initiative project.*					
#	*more examples of these types are known or expected in the Great Lakes ecoregion, but they were not compiled for this project, or included in this summary*					
+	*indicates alvar communities undersampled for this project, more examples and additional acreage are extant, and need documentation*					

the state or province, to S5 for demonstrably secure. Global and subnational ranks provide a quick indication of a species' or community's rarity and conservation status.

Each location of an ecological community or rare species on the land was documented as an "element occurrence" or EO. Each occurrence also was assigned a rank to reflect the quality and condition of that occurrence; this rank is called the "element occurrence rank" or "EO rank." This EO rank summarizes how any one occurrence of a species or community compares to all other known occurrences of that element. EO ranks range from "A" for excellent to "D" for poor. Occurrences ranked A through C are considered viable, whereas a D-ranked occurrence is not expected to survive, even with appropriate management efforts. Criteria for assigning EO ranks to alvar communities were standardized, based on size, condition, and landscape context to ensure that ranks were comparable across state, regional, and national boundaries.

One other aspect of alvar distribution that was used during evaluation is their relationship to ecoregions. Ecoregions are broad landscape areas with similar patterns of climate and landform; they are further subdivided into smaller units called "site districts" in Ontario and "subsections" in the United States. The boundaries of these site districts and subsections are shown on Map B.
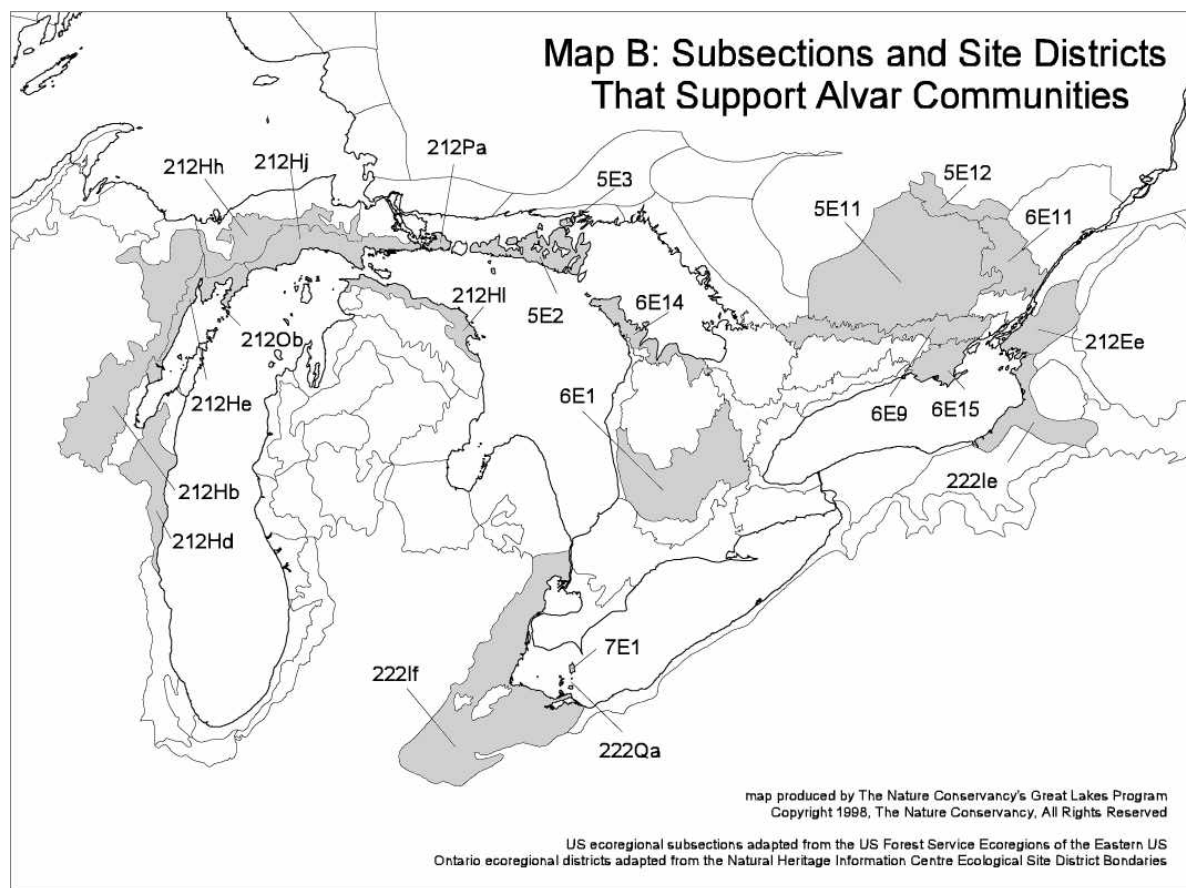
2.2 Alvar Communities

The 13 alvar communities recognized by the Alvar Working Group can be divided into three groups based on overall vegetation structure: 1) open grasslands and pavements, 2) shrublands, and 3) savannas and woodlands. These three groups are distinguished by the amount of exposed bedrock, the cover of herbaceous plants (mostly grasses and sedges), the cover of shrubs, and the cover of trees. Since most of these alvar community types occur in patchy and often complex landscape mosaics, the descriptions of the communities include a brief discussion of these patterns. Diagnostic characteristics to help distinguish among the communities in the field are also included. Technical descriptions of all alvar community types can be found in Appendix 3.

Alvar communities are naturally patchy. Collaborators decided that a patch would be considered large enough to map as an occurrence of an alvar

community if it was larger than 1.25 acres (0.5 ha), the smallest scale that could be interpreted on air photos. Therefore, the number of sites included in each community description (and in Table 2) takes into account only patches of at least 1.25 acres (0.5 ha); smaller patches were treated as part of the surrounding community.

Map B: Subsections and Site Districts That Support Alvar Communities

map produced by The Nature Conservancy's Great Lakes Program
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US ecoregional subsections adapted from the US Forest Service Ecoregions of the Eastern US
Ontario ecoregional districts adapted from the Natural Heritage Information Centre Ecological Site District Bondaries

Community names are brief descriptive names that are roughly equivalent to the common names of species. Community names do not include all the dominant species, but they often include diagnostic species (species that help identify the type). Full scientific names, as well as common names and global ranks, are provided in Table 1.

## 2.2.1 Open Alvar Grasslands and Pavements

Open alvar grassland and pavement communities have very few trees (less than 10% cover of trees over 5 m tall), a low cover of shrubs (less than 25% cover), and a high abundance of either herbaceous plants or exposed bedrock, which may be covered with crustose lichens and mosses. There are five open alvar types, briefly described below.

1. Tufted hairgrass wet alvar grassland

    This grassland community occurs in northern Michigan, Ontario, and northern New York (Map C). Thirty-six occurrences of this community were documented, with a total of about 3440 acres (1392

ha). It has a global rank of G2. The number of occurrences is a little higher than the usual range
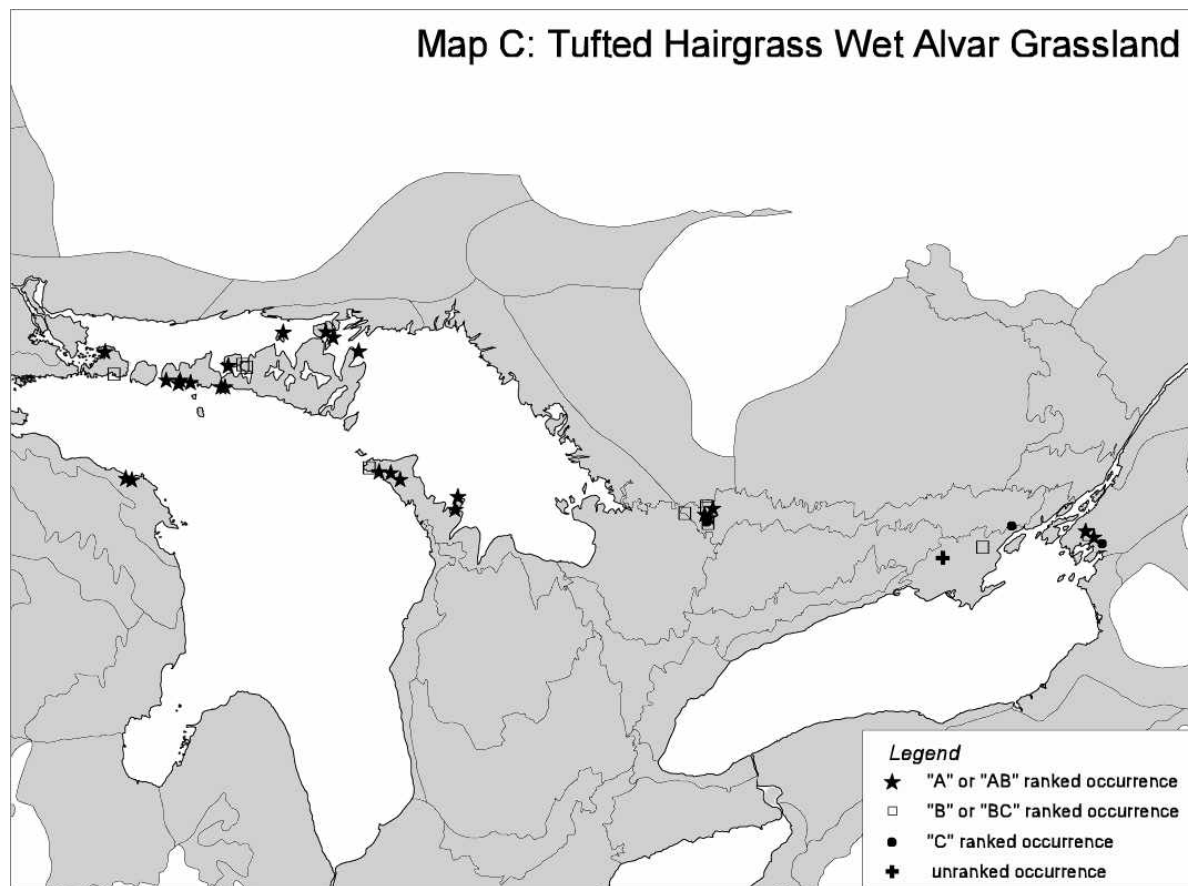
Tufted Hairgrass Wet Alvar
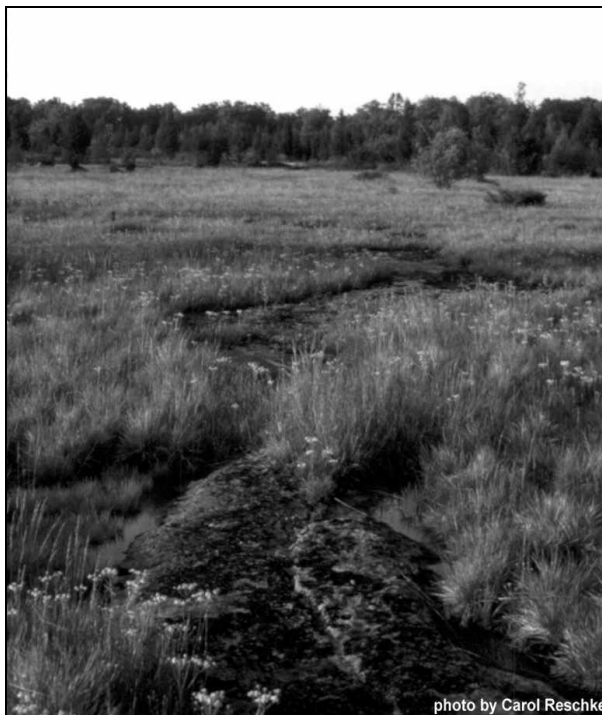Grassland at Chaumont Barrens, New York

photo by Carol Reschke

of 6 to 20 occurrences for a rank of G2, but the low total acreage, and significant threats from trampling by all terrain vehicles and other stressors, resulted in the G2 rank.

The dominant grasses and sedges are tufted hairgrass (*Deschampsia cespitosa*), Crawe's sedge (*Carex crawei*), prairie dropseed (*Sporobolus heterolepis*), and flat-stemmed spikerush (*Eleocharis compressa*). Other characteristic grasses and herbs include balsam ragwort (*Senecio pauperculus*), small rush grass (*Sporobolus neglectus*), sheathed rush grass (*S. vaginiflorus*), false pennyroyal *(Trichostema brachiatum)*, and wild chives (*Allium schoenoprasum*). Typically there are several turf and weft mosses forming a patchy mat at the base of grasses and forbs; typical mosses are marsh bryum *(Bryum pseudo-triquetrum)*, fern moss *(Abietinella abietinum)*, twisted moss *(Tortella tortuosa)*, and sickle-leaf feathermoss (*Drepanocladus* spp.) There are usually very few shrubs in this grassland community (usually less than 1% cover).

Tufted hairgrass wet alvar grasslands occur in small to large patches, ranging from under 2 acres to about 100 acres (0.8 to 40 ha). They usually occur in a patchy landscape mosaic with other alvar communities, including annual alvar pavement-grassland, little bluestem alvar grassland, alvar nonvascular pavement, and juniper alvar shrubland. In these landscape mosaics, the tufted hairgrass wet alvar grassland usually occupies the lowest, wettest positions; the

actual elevation differences may be very subtle, with differences of less than 10 or 15 cm. In Michigan, some areas mapped by the Michigan Natural Features Inventory as river ledge limestone pavement include patches of tufted hairgrass wet alvar grassland.

Tufted hairgrass wet alvar grasslands occur on very shallow, organic soils that cover limestone or dolostone bedrock. Average soil depths in this grassland community are less than 10 cm. This community has a characteristic soil moisture regime of alternating wet and dry seasons; many of them have flooded or saturated soils in early spring and late fall, combined with summer drought in most years.

Diagnostic characteristics of tufted hairgrass wet alvar grassland are:
- → open canopy: less than 10% cover of trees
- → few shrubs: less than 10% cover of shrubs
- → groundlayer is dominated by grasses and sedges
- → occurs on shallow, organic soils, usually less than 10 cm deep over flat limestone or dolostone bedrock
- → soils are often wet (saturated or flooded) in spring and fall and very dry in midsummer
- → dominant species are tufted hairgrass, Crawe's sedge, prairie dropseed, and flat-stemmed spikerush.

2. Little bluestem alvar grassland

This grassland community occurs primarily in the western Great Lakes alvars of northern Michigan, Manitoulin Island and vicinity, and on the Bruce Peninsula, with a few occurrences further east in Carden Plains and Burnt Lands (Map D). Thirty-six occurrences of this community were documented, with a total of about 7074 acres (2860 ha). It has a global rank of G2. Although this community has twice the acreage as tufted hairgrass wet alvar grassland, it has the same global rank due to imminent threats to the single largest occurrence, which makes up nearly half the total acreage.

Characteristic species of the grassland are prairie dropseed (*Sporobolus heterolepis),* little bluestem, *(Schizachyrium scoparium),* creeping juniper *(Juniperus horizontalis),* northern singlespike sedge (*Carex scirpoidea),* tufted hairgrass, *(Deschampsia cespitosa),* balsam ragwort *(Senecio pauperculus),* and Crawe's sedge *(Carex crawei).* The grasses and sedges usually have at least 50% cover. There is usually less than 10% cover of shrubs over 0.5 m tall;
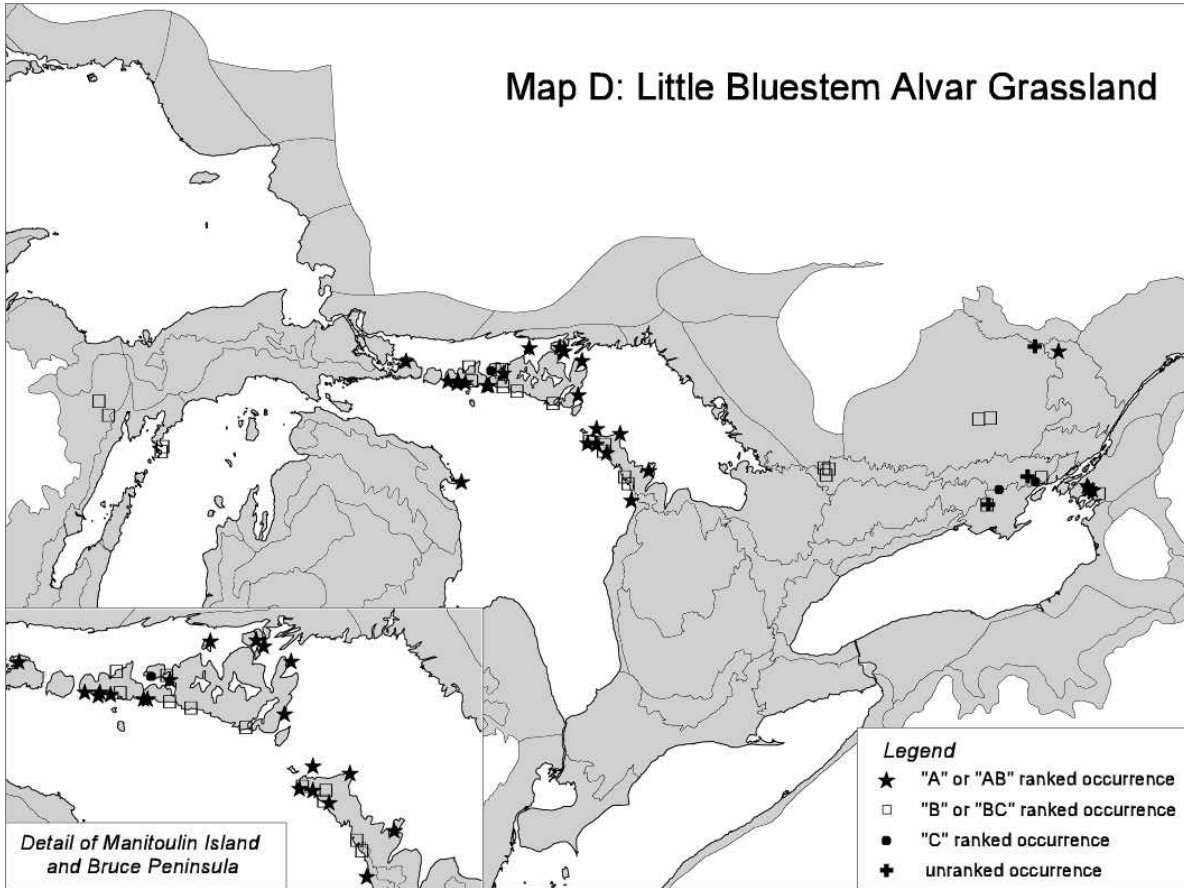
however, there may be as much as 50% cover of dwarf shrubs (under 0.5 m tall), especially creeping juniper. This dwarf shrub is shorter than the dominant grasses and usually is found under the canopy of grasses, so the physiognomic type is here considered a grassland (in spite of a relatively high cover of dwarf shrubs). Less than 50% of the ground surface is exposed bedrock (including bedrock covered with nonvascular plants, such as lichens, mosses, and algae).

Little bluestem alvar grasslands occur in small to large patches, ranging in size from less than 5 acres to over 3000 acres (<2 to >1214 ha). In larger patches over 50 acres (20 ha) this grassland often occurs as a small-scale matrix, with smaller patches of other alvar communities occurring within the larger patch of little bluestem alvar grassland, forming a landscape mosaic. The most commonly associated alvar communities are creeping juniper - shrubby cinquefoil alvar pavement, tufted hairgrass wet alvar grassland, alvar nonvascular pavement, and white cedar - jack pine / shrubby cinquefoil alvar savanna.

Soils of little bluestem alvar grasslands are very shallow (usually less than 20 cm deep, average is about 6 cm deep) and patchy over limestone or dolostone bedrock. Soils are loams high in organic matter. This community often has a characteristic soil moisture regime of alternating wet and dry periods: they can have wet, saturated soils in spring and fall, combined with summer drought in most years (except unusually wet years).

Map D: Little Bluestem Alvar Grassland

Legend
- ★ "A" or "AB" ranked occurrence
- ☐ "B" or "BC" ranked occurrence
- ● "C" ranked occurrence
- ✚ unranked occurrence

Detail of Manitoulin Island and Bruce Peninsula

Little Bluestem Alvar Grassland at
LaCloche Alvar, north of Manitoulin Island, Ontario

photo by Carol Reschke

Diagnostic characteristics of little bluestem alvar grassland are:

→ open canopy: less than 10% cover of trees

→ few shrubs: less than 25% cover of shrubs over 0.5 m tall

→ dwarf shrubs under 0.5 m tall, especially creeping juniper may have up to 50% cover, but they are mostly found under a taller canopy of grasses or sedges

→ groundlayer is dominated by grasses and sedges, less than 50% of the ground surface is exposed limestone or dolostone bedrock

→ occurs on shallow, loam soils, usually less than 10 cm deep over flat limestone dolostone bedrock

→ soils are often wet (saturated) in spring and fall and very dry in midsummer

→ dominant species are prairie dropseed, little bluestem, or northern singlespike sedge; tufted hairgrass may be present but is never dominant; creeping juniper is common, but mostly is found overtopped by the grassy layer.

3. Annual alvar pavement-grassland

This community type occurs in Ontario and New York (Map E), with 16 occurrences and a total of over 490 acres (201 ha); additional surveys are needed to document the size of this community at some sites. This community has a global rank of G2.
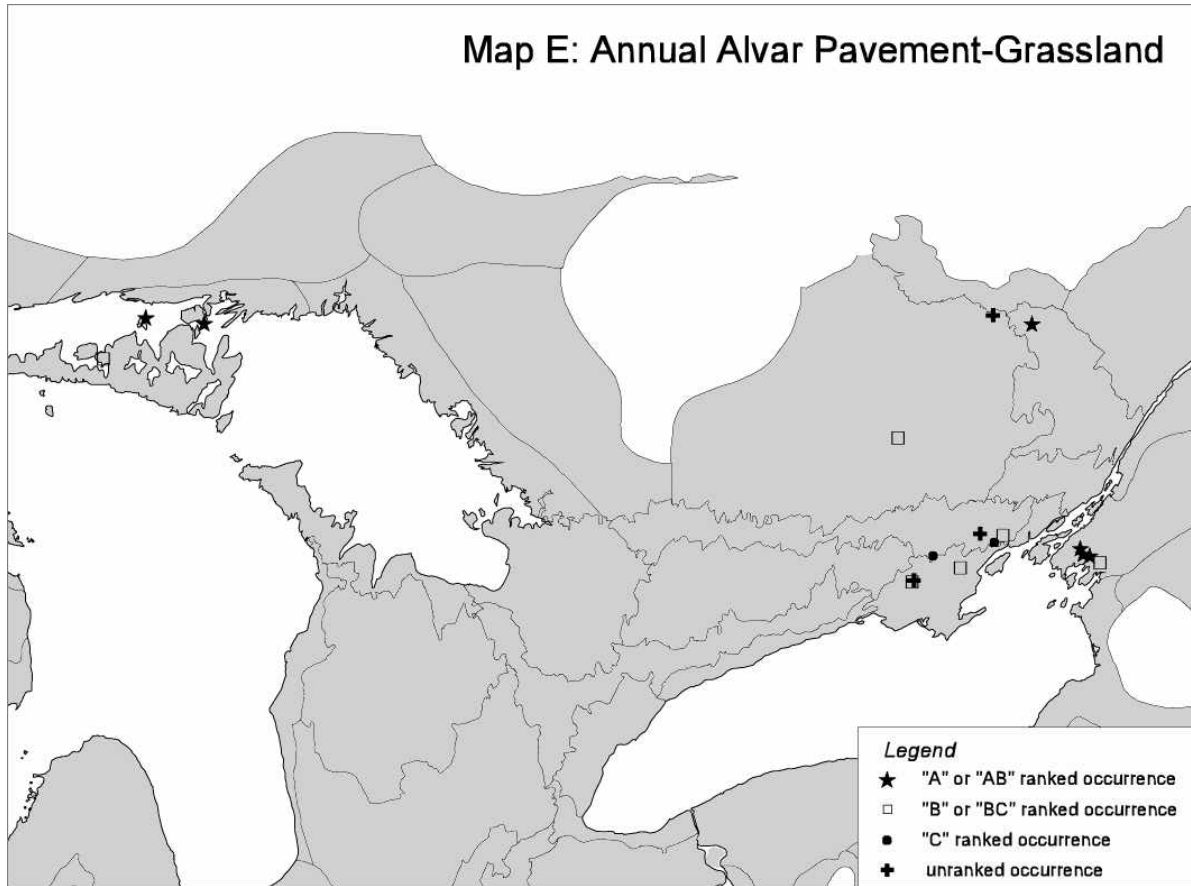
This community consists of a mosaic of pavement and grassland areas dominated by characteristic native species, such as small rush grass (*Sporobolus neglectus),* sheathed rush grass *(S. vaginiflorus),* Philadelphia panic grass *(Panicum philadelphicum),* Canada bluegrass *(Poa compressa),*upland white aster *(Solidago ptarmicoides),*poverty grass *(Danthonia spicata),* false pennyroyal *(Trichostema brachiatum),*balsam ragwort *(Senecio pauperculus),* Crawe's sedge *(Carex crawei),* and wiry panic grass (*Panicum flexile).* There is usually less than 10% cover of shrubs. There may be nearly equal cover of grassy vegetation, and exposed rock covered with nonvascular plants. Lichens and mosses are common on "pavement" rock outcrops that occur as patches within this mosaic.

Annual alvar pavement-grasslands usually occur in small to large patches; sizes of currently known occurrences range from under 2 acres to about 200 acres (0.8 to about 81 ha). This community typically occurs in a landscape mosaic with other alvar communities; the most common associated communities are tufted hairgrass wet alvar grassland, juniper

alvar shrubland, alvar nonvascular pavement, little bluestem alvar grassland, and poverty grass dry alvar grassland.

Map E: Annual Alvar Pavement-Grassland

Legend
★ "A" or "AB" ranked occurrence
□ "B" or "BC" ranked occurrence
● "C" ranked occurrence
✚ unranked occurrence

Annual Alvar Pavement-Grassland
at Howe's Road Alvar, Napanee Plain, Ontario

photo by Wasyl Bakowsky

Soils of annual alvar pavement-grasslands are very shallow (usually less than 10 cm deep) over limestone or dolostone bedrock. At some sites there is a distinctive soil moisture regime of alternating wet and dry seasons: they are often saturated in early spring and late fall and subject to severe summer drought in most years (except unusually wet years). Due to the very shallow soils, and often saturated conditions during freeze-thaw cycles in early and late winter, needle ice often forms in the soils, causing frost-heaving of the shallow soils.

Diagnostic characteristics of annual alvar pavement-grassland are:
- → open canopy: less than 10% cover of trees
- → few shrubs: less than 25% cover of shrubs
- → groundlayer is dominated by annual grasses and herbs or a mosaic of mossy pavement patches and grassy patches
- → occurs on shallow, loam soils, usually less than 10 cm deep over flat limestone or dolostone bedrock
- → soils are often wet (saturated) in spring and fall, very dry in midsummer, subject in winter to needle-ice formation which turns over small blocks of soil
- → characteristic species are small rush grass, sheathed rush grass, Philadelphia panic grass, wiry panic grass, and false pennyroyal.
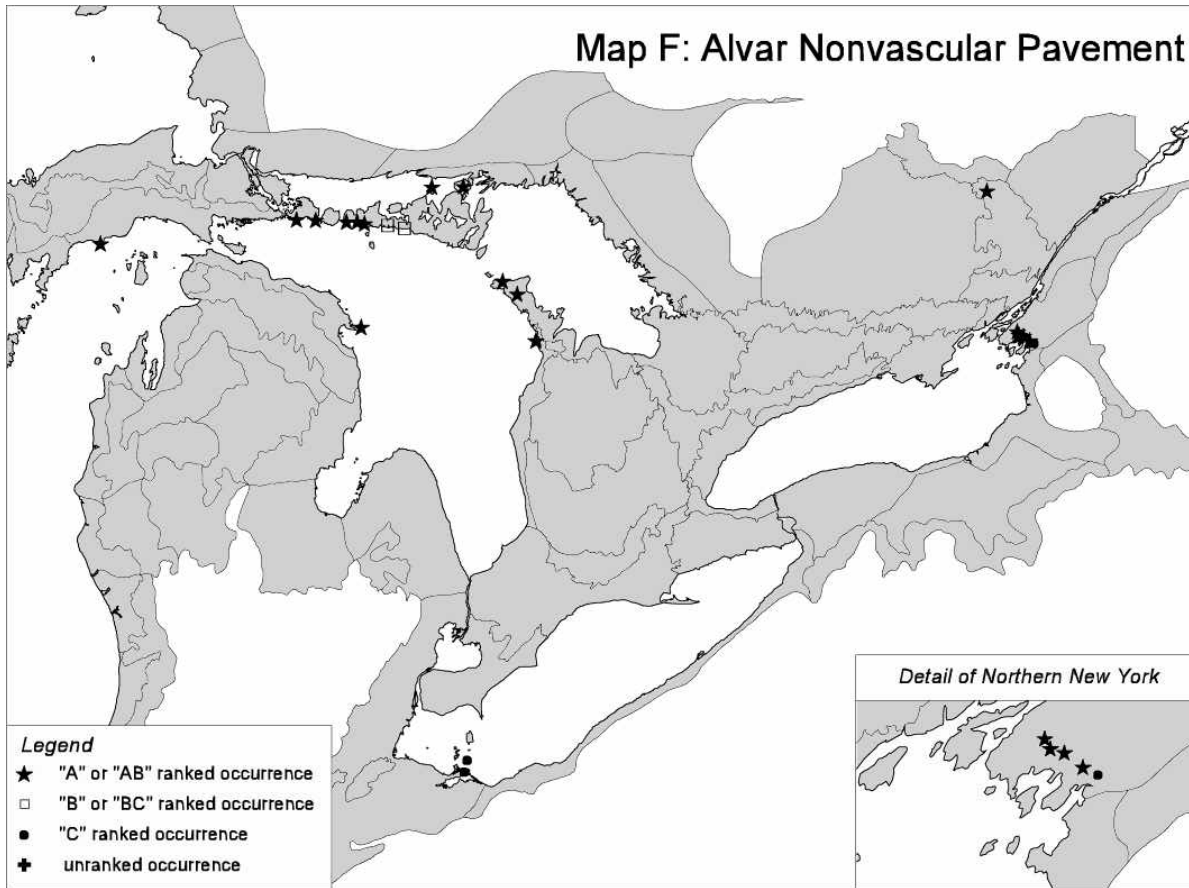
4. Alvar nonvascular pavement

This rock outcrop community occurs throughout the Great Lakes basin, with the largest examples near Lake Huron on the southern shore of Manitoulin Island and the western shore of the Bruce Peninsula (Map F). Nineteen occurrences of this community met the minimum mapping criterion of at least 1.25 acres (0.5 ha), with a total area of about 1424 acres (576 ha). This community is frequently observed in small patches (smaller than 1.25 acres) within other alvar communities. It has a global rank of G2.

This community consists of exposed, flat limestone or dolostone pavement that is sparsely vegetated with a mosaic of mossy patches and exposed bedrock that is covered with crustose and foliose lichens. In the mossy patches, characteristic mosses are twisted moss *(Tortella tortuosa,* and other *Tortella* spp.)* and tortula moss *(Tortula ruralis)*, and a characteristic lichen is cup lichen *(Cladonia pocillum)*. On exposed pavement patches, characteristic lichens are blackthread lichen *(Placynthium nigrum)* and silver skin lichen *(Dermatocarpon* cf *miniatum)*. Very small herbs (under 15

cm tall) grow in the mossy patches, including Virginia saxifrage *(Saxifraga virginiensis),* hairy beardtongue *(Penstemon hirsutus),* Norwegian cinquefoil *(Potentilla norvegica),* false pennyroyal *(Trichostema brachiatum),* Virginia strawberry *(Fragaria virginiana),* Michaux's stitchwort *(Minuartia michauxii var. michauxii),* and longleaf summer bluet *(Houstonia longifolia).* Some taller herbs and low shrubs grow primarily in rock crevices that

Map F: Alvar Nonvascular Pavement

Detail of Northern New York

Legend
★ "A" or "AB" ranked occurrence
□ "B" or "BC" ranked occurrence
● "C" ranked occurrence
✚ unranked occurrence

Alvar Non-vascular Pavement at
Dyer's Bay Road/Brinkman's Corners, Bruce Peninsula, Ontario

photo by Wasyl Bakowsky

crisscross the pavement, including gray goldenrod *(Solidago nemoralis),* snowberry *(Symphoricarpos albus),* riverbank grape *(Vitis riparia),* red columbine *(Aquilegia canadensis),* and tall hawkweed *(Hieracium piloselloides).*

There is usually less than 15% cover of herbs. A few trees and shrubs are usually rooted in deep crevices of the pavement; characteristic trees and shrubs that occur sparsely include eastern white cedar (*Thuja occidentalis),* common juniper *(Juniperus communis),* white birch *(Betula papyrifera),* eastern red cedar *(Juniperus virginiana),* butternut *(Juglans cinerea),* and white pine *(Picea glauca).* There is less than 10% total cover of trees, and less than 10% total cover of shrubs. There is a lot of exposed bedrock and much of it is covered with lichens and mosses (average cover of lichens and mosses is about 55%).

Alvar nonvascular pavements usually occur in small to large patches; sizes of currently documented patches range from under 1.25 acres to over 200 acres (<0.5 to >80 ha). They usually occur in a patchy landscape mosaic with other alvar communities, including annual alvar pavement-grassland, creeping juniper - shrubby cinquefoil alvar pavement, little bluestem alvar grassland, tufted hairgrass wet alvar grassland, and juniper alvar shrubland.

Soils of alvar nonvascular pavement are either lacking or very shallow (usually less than 10 cm deep in crevices) over limestone or dolostone bedrock. This community typically has a soil moisture regime characterized by severe summer drought as well as high summer temperatures.

Diagnostic characteristics of alvar nonvascular pavement are:
- → open canopy: less than 10% cover of trees
- → few shrubs: less than 10% cover of shrubs
- → groundlayer is primarily exposed limestone or dolostone bedrock covered with lichens and mosses
- → soils are lacking, or restricted to rock crevices (grikes), or a very shallow layer (less than 2 cm) underneath a mossy mat
- → characteristic species are lichens and mosses (such as cup lichen, blackthread lichen, twisted moss), Virginia saxifrage, hairy beardtongue, Norwegian cinquefoil, and false pennyroyal.
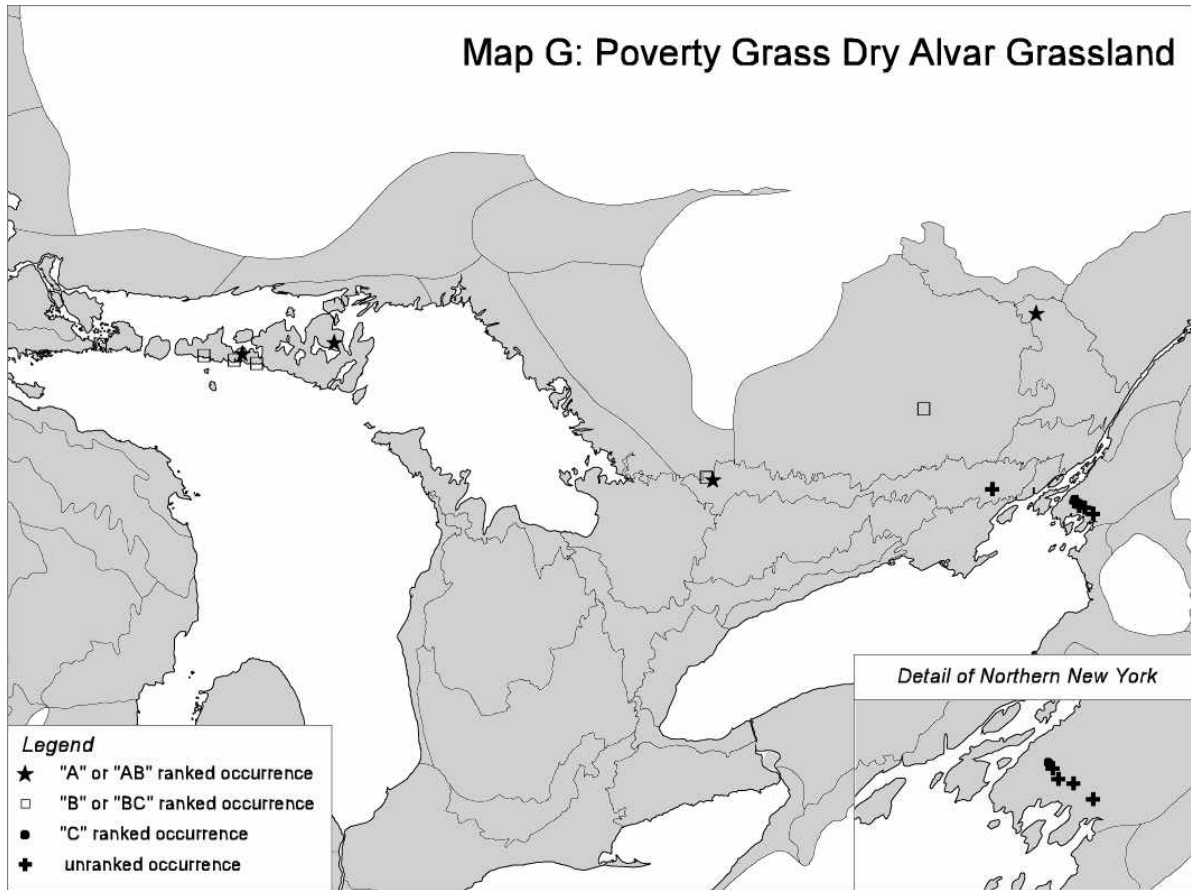
5. Poverty grass dry alvar grassland

     This grassland occurs in Ontario, New York, and Michigan (Map G), with 17 documented occurrences and a total area of over 467 acres (189 ha). There may be many more occurrences of this community, but many are very disturbed by grazing and dominated by exotic species. It has a global rank of

Map G: Poverty Grass Dry Alvar Grassland

Detail of Northern New York

Legend
★   "A" or "AB" ranked occurrence
☐   "B" or "BC" ranked occurrence
●   "C" ranked occurrence
✚   unranked occurrence

Poverty Grass Dry Alvar Grassland at
Evansville Shrubland, Manitoulin Island, Ontario

photo by Judith Jones

G2? (The ? denotes some uncertainty about the ranking). This dry grassland is dominated by poverty grass (*Danthonia spicata),* Canada bluegrass *(Poa compressa),* and sometimes little bluestem *(Schizachyrium scoparium).* There is less than 10% cover of trees and less than 25% cover of shrubs. There is usually about 50% cover of herbs and up to about 50% cover of nonvascular plants (mosses, lichens, and algae) growing on exposed limestone or dolostone pavement areas that occur as patches within the grassland.

Poverty grass dry alvar grassland usually occurs in small to large patches. Sizes of currently known occurrences range from under 2 acres to about 100 acres (0.8 to 40 ha). This community may occur in a patchy landscape mosaic with other alvar communities, most commonly juniper alvar shrubland and annual alvar pavement-grassland.

Soils of poverty grass dry alvar grasslands are very shallow loams (usually less than 10 cm deep) over limestone or dolostone bedrock. These grasslands are sometimes disturbed by grazing, which introduces exotic species and pasture grasses such as timothy (*Phleum pratense*). This community has a characteristic soil moisture regime of summer drought in most years. This grassland seems to occur on well-drained soils that are rarely, if ever, saturated or flooded; this interpretation is based on soil texture (soil moisture regime of this type has not been studied).

Diagnostic characteristics of poverty grass dry alvar grassland are:
 → open canopy: less than 10% cover of trees
 → few shrubs: less than 25% cover of shrubs
 → grasses are the dominant in the groundlayer, but patches of exposed pavement covered with lichens and mosses may be present
 → soils are well-drained, shallow loams over limestone or dolostone bedrock
 → characteristic species are poverty grass, Canada bluegrass, and sometimes little bluestem

2.2.2 Alvar Shrublands

Alvar shrubland communities have very few trees (less than 10% covers of trees over 5 m tall), moderate to high cover of shrubs (at least 25% cover of shrubs),

and variable amounts of cover of herbaceous and nonvascular plants. There are three alvar shrubland types, which are briefly described below.

6. Creeping juniper - shrubby cinquefoil alvar pavement

This dwarf-shrubland community occurs in Ontario (primarily on the Bruce Peninsula, Manitoulin Island, the islands north of Manitoulin) and at three sites in northern Michigan (Map H). Twenty-four occurrences of this community were documented, with a total area of about 2700 acres (1093 ha). It has a global rank of G2.

This community has at least 25% cover of dwarf shrubs (under 0.5 m tall); the dominant shrubs are creeping juniper *(Juniperus horizontalis)* and/or shrubby cinquefoil *(Pentaphylloides floribunda).* Other characteristic species include little bluestem *(Schizachyrium scoparium),* Richardson's sedge *(Carex richardsonii),* northern singlespike sedge *(C. scirpoidea),* jack pine *(Pinus banksiana),* eastern white cedar *(Thuja occidentalis),* poverty grass *(Danthonia spicata),* upland white aster *(Solidago ptarmicoides),* balsam ragwort *(Senecio pauperculus),* limestone calamint *(Calamintha arkansana),* and lakeside daisy (*Hymenoxys herbacea).* This community has less than 50% cover of herbaceous plants, and less than 10% cover of trees over 5 m tall.
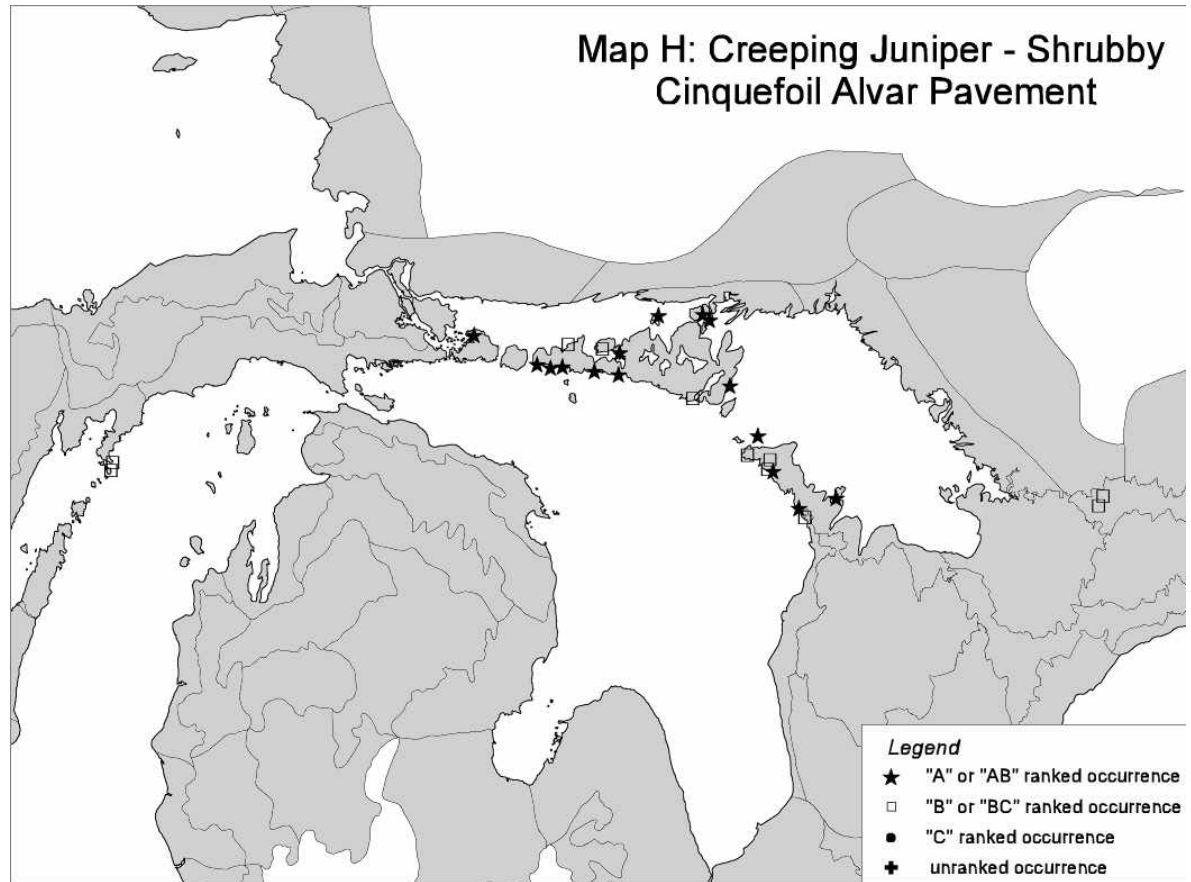
This community is closely related to little bluestem alvar grassland, and the two communities are frequently interspersed. The primary distinction is that the creeping juniper - shrubby cinquefoil alvar pavement community has dwarf shrubs as the tallest vegetation layer covering at least 25% of the area, whereas little bluestem alvar grassland has grasses and sedges as a taller layer, with dwarf shrubs, especially creeping juniper, growing primarily underneath the grasses and sedges. There is often a lot of exposed dolostone bedrock pavement, but exposed bedrock is always less than 50% of the ground surface area. Much of the exposed rock surface is covered with microscopic algae (e.g. *Gloeocapsa alpina*). Mosses and lichens are common, including twisted moss *(Tortella tortuosa)* and common grimmia (*Schistidium rivulare),* blackthread lichen *(Placynthium nigrum)* and Iceland 'moss' *(Cetraria arenaria,* a lichen*).*

Creeping juniper - shrubby cinquefoil alvar pavement occurs in small to large patches. Sizes of currently known occurrences range from under 5 acres to about 550 acres (2 to about 220 ha). They usually occur in a patchy landscape mosaic with other alvar communities, most commonly with little bluestem alvar grassland, tufted hairgrass wet alvar grassland, juniper alvar shrubland, and alvar nonvascular pavement.

Soils of creeping juniper - shrubby cinquefoil alvar pavement are very shallow (usually less than 10 cm deep) over dolostone bedrock. The surface of the dolostone pavement is often broken into small pieces (from 1 cm to 1 m in the longest dimension) by frost heaving; the Alvar Working Group refers to this type of pavement as rubble pavement. These pavements are typically very droughty in summer, except immediately after rainfall when ephemeral shallow pools can form on the bedrock surface.

Map H: Creeping Juniper - Shrubby Cinquefoil Alvar Pavement

Legend
★ "A" or "AB" ranked occurrence
□ "B" or "BC" ranked occurrence
● "C" ranked occurrence
✚ unranked occurrence

Creeping Juniper -Shrubby Cinquefoil Alvar Pavement
at LaCloche Alvar, North of Manitoulin Island, Ontario

photo by Carol Reschke

Diagnostic characteristics of creeping juniper - shrubby cinquefoil alvar pavement are:

→ open canopy: less than 10% cover of trees

→ less than 10% cover of shrubs over 0.5 m tall

→ more than 25% cover of dwarf-shrubs (under 0.5 m tall)

→ less than 50% cover of herbs (including grasses and sedges)

→ patches of exposed pavement covered with lichens and mosses are common, but they cover less than 50% of the ground surface

→ soils are shallow loams (usually less than 10 cm deep) over dolostone or limestone bedrock, often broken

→ characteristic species are creeping juniper, shrubby cinquefoil, little bluestem, Richardson's sedge, and northern singlespike sedge.

7. Scrub conifer / dwarf lake iris alvar shrubland

This shrubland community occurs in northern Michigan, and in Ontario on the south shores of Manitoulin Island and the Bruce Peninsula (Map I). Ten occurrences of this community were documented, with a total area of 815 acres (330 ha). It has a global rank of G1G2.

This community has over 25% cover of tall and short shrubs. The tall shrubs (2 to 5 m tall) in this shrubland are scrub forms of tree species such as white spruce *(Picea glauca),* eastern white cedar *(Thuja occidentalis),* tamarack *(Larix laricina),* and balsam fir *(Abies balsamea).* There is less than 10% cover of trees over 5 m tall. The typical short shrubs (0.5 to 2 m tall) are common juniper *(Juniperus communis),*chokecherry *(Prunus virginiana),* bush honeysuckle *(Diervilla lonicera),* buffalo-berry *(Shepherdia canadensis),* red-osier dogwood *(Cornus sericea),* and alderleaf buckthorn *(Rhamnus alnifolia).*
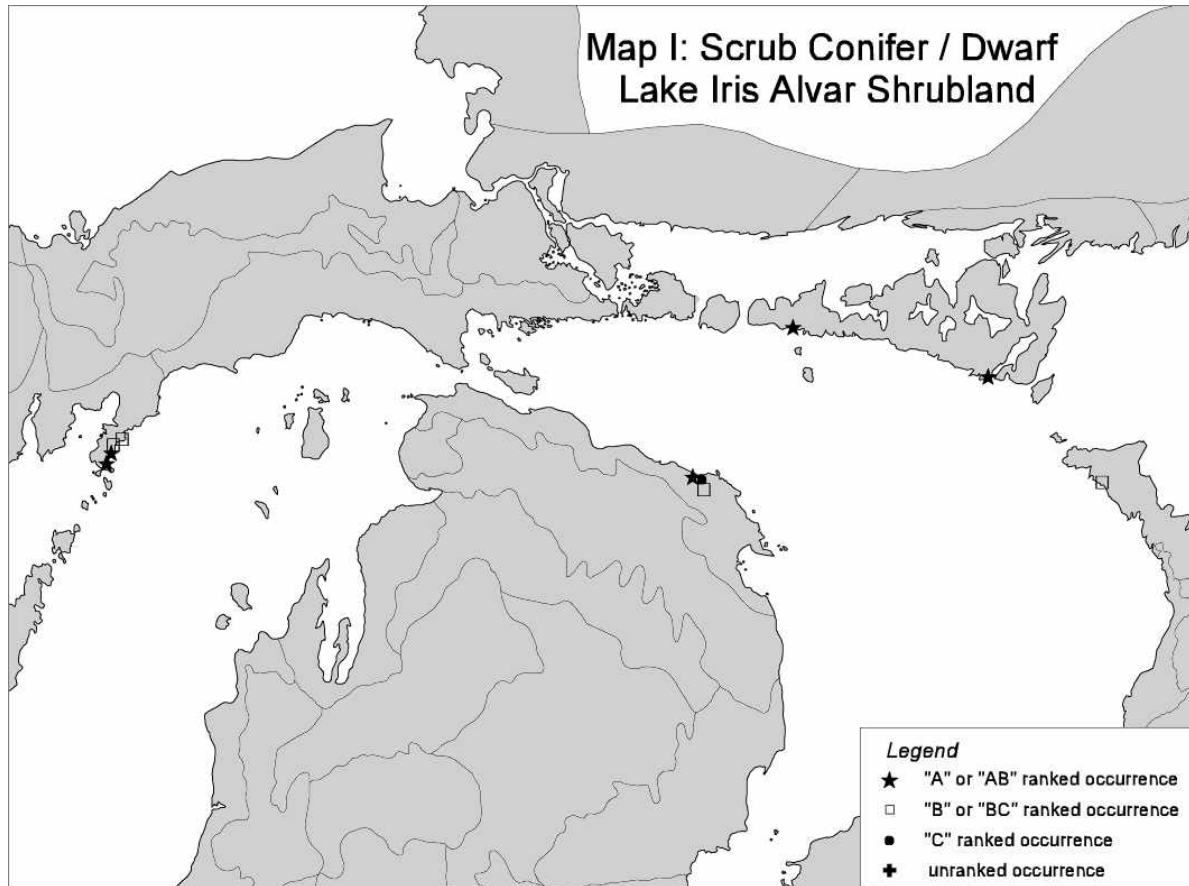
Underneath and between the shrubs is a "lawn" dominated by dwarf lake iris (*Iris lacustris)* and ebony sedge *(Carex eburnea).* Other characteristic species are bearberry *(Arctostaphylos uva-ursi),* Richardson's sedge *(Carex richardsonii),* and poverty grass *(Danthonia spicata).* The herbaceous layer has an average of 82% cover. Less than 10% of the ground surface is exposed bedrock, including bedrock covered with lichens and mosses.

Scrub conifer / dwarf lake iris alvar shrublands usually occur in small to large patches. Sizes of currently known occurrences range from under 5 acres to about 300 acres (2 to 120 ha). This community often occurs as

openings within a forested landscape; it is not always associated with other alvar communities. When it occurs in a landscape mosaic with other alvar communities, this community typically occurs as small patches adjacent to little bluestem alvar grassland, creeping juniper - shrubby cinquefoil alvar pavement, and tufted hairgrass wet alvar grassland.

Map I: Scrub Conifer / Dwarf Lake Iris Alvar Shrubland

Legend
★ "A" or "AB" ranked occurrence
□ "B" or "BC" ranked occurrence
● "C" ranked occurrence
✚ unranked occurrence

Scrub Conifer / Dwarf Lake Iris Alvar Shrubland
at Kregg Bay Glade, Garden Peninsula, Michigan

photo by Michigan Natural Features Inventory

Soils of scrub conifer / dwarf lake iris alvar shrublands are very shallow organic soils (usually 20 to 30 cm deep) over limestone or dolostone bedrock. This community has a characteristic soil moisture regime of seasonal flooding or saturation in early spring and late fall, combined with summer dry periods in most years (except unusually wet years).

Diagnostic characteristics of scrub conifer / dwarf lake iris alvar shrubland are:

→ open canopy: less than 10% cover of trees over 5 m tall

→ more than 25% cover of shrubs (0.5 to 5 m tall), including stunted or scrub trees

→ usually more than 50% cover of herbs (including grasses and sedges) forming a dense "lawn" underneath and between the shrubs

→ soils are shallow, organic soils (usually 20 to 30 cm deep) over dolostone or limestone bedrock

→ characteristic species are dwarf lake iris, ebony sedge, and scrub forms of white spruce, eastern white cedar, tamarack, and balsam fir
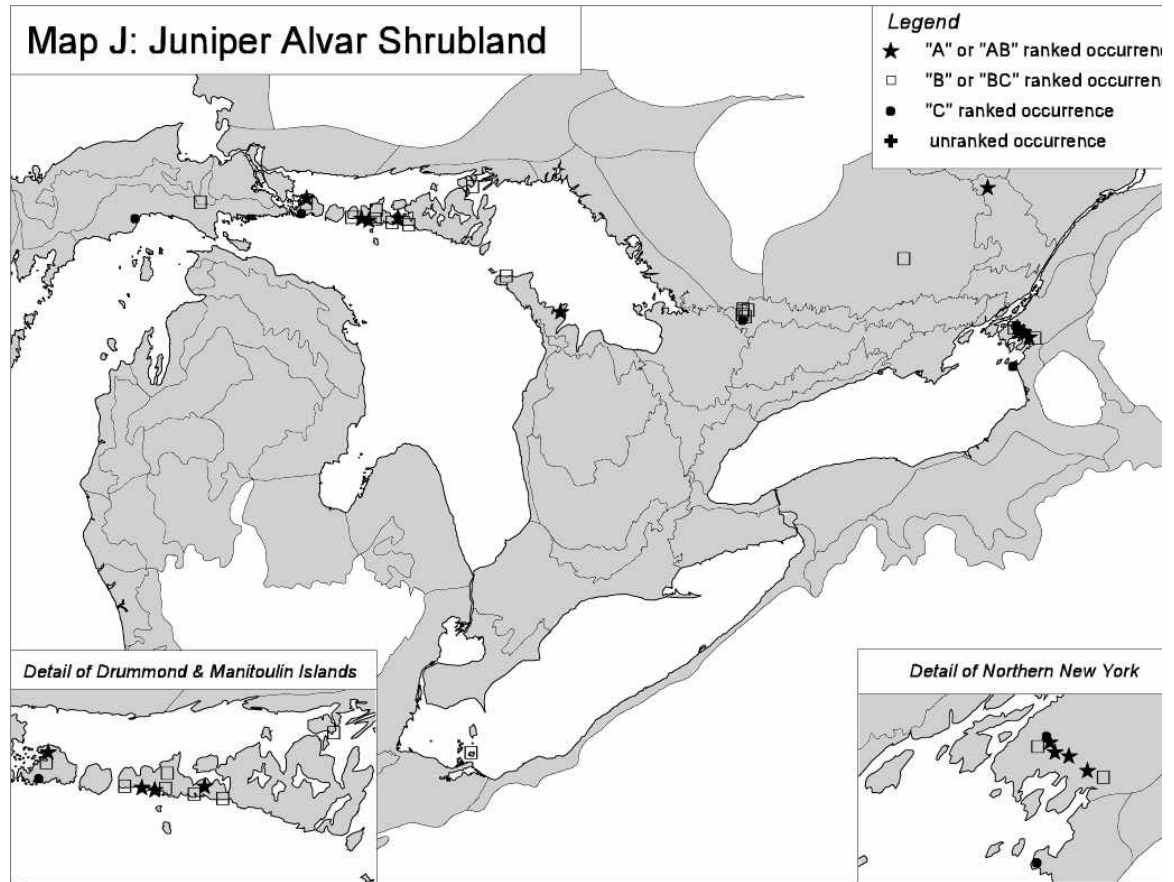
8. Juniper alvar shrubland

This community occurs throughout the Great Lakes basin in New York, Ontario, Ohio, Michigan, and Wisconsin (Map J). Thirty-five occurrences of this community were documented, with a total of about 7768 acres (3144 ha). It has a global rank of G3. The lower global rank of this community (compared to alvar grasslands with similar numbers of occurrences and acres) reflects the expectation that there are more examples of this community not yet surveyed, including some sites too disturbed to be considered viable. The threats to this community do not seem to be as imminent as threats to the alvar grasslands, and since the soils are only briefly saturated (just after a rainfall), they are less vulnerable to disturbance by off-road vehicles.

This shrubland has over 25% cover of tall, short, and dwarf shrubs; the average is about 43% cover of shrubs, with less than 10% of that being tall shrubs. Characteristic tall shrubs (2 to 5 m tall) are scrub forms of trees such as eastern red cedar *(Juniperus virginiana),* eastern white cedar *(Thuja occidentalis),* and bur oak *(Quercus macrocarpa).* Tree forms (over 5 m tall) of these species may be present, but trees have less than 10% cover in the community. Other less common trees (over 5 m tall) that may be present include shagbark hickory *(Carya ovata),* rock elm *(Ulmus thomasii),*

and white ash *(Fraxinus americana).* Characteristic short shrubs (0.5 to 2 m tall) include common juniper *(Juniperus communis),* gray dogwood *(Cornus foemina* spp. *racemosa),* fragrant sumac *(Rhus aromatica),* chokecherry *(Prunus virginiana*), and downy arrow-wood *(Viburnum rafinesquianum).* Some dwarf shrubs (under 0.5 m tall) are usually present, including bearberry *(Arctostaphylos uva-ursi)* and snowberry *(Symphoricarpos albus).* Characteristic vines include poison ivy *(Toxicodendron radicans)* and riverbank grape *(Vitis riparia).*

Juniper Alvar Shrubland at Carden Plains, Ontario

The herb layer forms a dry, grassy meadow between the shrubs; average cover of herbs is about 23%. The most abundant herbs are poverty grass *(Danthonia spicata),* upland white aster *(Solidago ptarmicoides),* and the sedge *Carex umbellata.* Less than 50% of the ground surface is exposed limestone bedrock, which is usually covered with lichens, mosses, and algae. There are often deep crevices or grikes in the limestone pavement; trees and shrubs are often rooted in the grikes.

Juniper alvar shrubland occurs in small to large patches; some of the larger patches form a small-scale matrix within which smaller openings of alvar grasslands and pavements may occur. Sizes of currently known occurrences range from under 10 acres to about 1600 acres (4 to about 650 ha).   They often occur in a patchy landscape mosaic with other alvar communities, including tufted hairgrass wet alvar grassland, little bluestem alvar grassland, annual alvar pavement-grassland, alvar nonvascular pavement, and poverty grass dry alvar grassland.

Soils of juniper alvar shrublands are very shallow (usually less than 0.3 m deep) over limestone bedrock. The soil moisture regime typically includes summer drought in most years (except unusually wet years).

Diagnostic characteristics of juniper alvar shrubland are:
- → open canopy: less than 10% cover of trees over 5 m tall
- → more than 25% cover of shrubs (0.5 to 5 m tall), including stunted or scrub trees
- → variable cover of herbs (including grasses and sedges) forming a dry, grassy meadow between the shrubs
- → small patches of exposed limestone bedrock pavement are usually present, often with deep crevices or grikes in which trees and shrubs may be rooted; exposed pavement covers less than 50% of the ground surface
- → soils are shallow loams or sandy loams (usually less than 30 cm deep) over limestone bedrock, well-drained, and usually very dry in midsummer
- → characteristic species include common juniper, downy arrow-wood, fragrant sumac, upland white aster, poverty grass, eastern red cedar, eastern white cedar, and bur oak.